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(54) Abstract Title
Orange paint composition

(57) A paint composition suitable for use at high temepratures (up to 600°C) of a substantially orange colour comprising bismuth vanadate ($BiVO_4$), ferric (III) oxide (Fe_2O_3), a binder, and a solvent. In a particular embodiment of the invention the paint comprises the following composition:-

	% by weight excl. solvent
Bismuth Vanadate	30.5 %
Ferric III Oxide	13.5 %
Silicone Resin	28 %
Acrylic Resin	28 %

and the solvent. The solvent in this embodiment is a blend of propylene glycol ethers, and in particular comprises 79.1% 1-methyoxy-2 propanol and 20.9% dipropylene glycol monomethyl ether. The amount of solvent being varied depaending upon the particular method of applying the paint.

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A PAINT COMPOSITION

The present invention relates generally to a paint or coating composition and in particular to a high temperature resistant coloured paint or coating.

Paints of a substantially orange colour are used in a large number of applications, with the orange colour allowing increased visibility and identification of a painted object when compared with other colours. If the object is subject to high temperatures (up to 600°C) then the paint must accordingly be stable, or able to withstand, these operating temperatures. One example of such an orange paint, suitable for use at elevated temperatures, is International Orange (PL 155) produced by Indestructible Paints Ltd (Birmingham).

This paint and other similar paints currently available tend to be based on either lead, cadmium, nickel, or chromium based pigments. This being particularly so with paints of a substantially orange colour. Such pigments containing lead, chromium, nickel, or cadmium are suspected to be toxic and their use is being discouraged.

Alternative paints not based on pigments containing the above elements have been suggested. However these tend to be based upon organic pigments and are unsuitable for use at high temperatures.

It is therefore an object of this invention to provide a paint of a substantially orange based colour, which is stable and suitable for use at high temperatures and is free from lead, chromium, cadmium, or nickel.

According to the present invention there is provided a paint comprising bismuth vanadate, ferric oxide, a binder, and a solvent.

Preferably the binder is a resin. Furthermore the binder may be a mixture of a silicone resin and an acrylic resin. The proportions, by weight, of silicone and acrylic resins may be in the range from 1:0.8 to 1:1.2. Additionally the acrylic resin may be polybutyl methacrylate. The resins may themselves be mixed with a second solvent. This second solvent may be xylene.

Preferably the solvent is a blend of propylene glycol ethers. Furthermore the solvent may be a mixture of 1-methyoxy-2 propanol and dipropylene glycol monomethyl ether. Preferably the solvent comprises substantially 79.1% 1-methyoxy-2 propanol and 20.9% dipropylene glycol monomethyl ether.

Preferably the ferric oxide and bismuth vanadate make up to 50 % by weight of the paint composition excluding the solvent.

The paint preferably comprises the following composition:

	% by weight excl. solvent
Bismuth Vanadate	30.5 %
Ferric III Oxide	13.5 %
Silicone Resin	28 %
Acrylic Resin	28 %

and the solvent.

There may be substantially two parts of bismuth vanadate to one part ferric oxide.

According to another aspect of the invention there is provided a method of applying a paint, of a composition described in the claims, comprising the steps of:-

a) Applying the liquid paint to an object,

b) Heating the object to drive off the solvent within the paint, and dry the paint on the object.

The present invention will now be described by way of example.

The paint comprises a mixture of bismuth vanadate ($BiVO_4$), ferric (III) oxide (Fe_2O_3), a binder and a solvent. The composition of one example of the paint is shown in table 1 below.

Table 1

Component	% by Wt	% by Wt excl. solvent
Bismuth Vanadate ($BiVO_4$)	23.5 %	30.5 %
Ferric (III) Oxide (Fe_2O_3)	10.5 %	13.5 %
Silicone Resin	22 %	28 %
Acrylic Resin (Polybutyl methacrylate)	22 %	28 %
Solvent	22%	-

The pigments used, in this example of a paint according to the invention, are the bismuth vanadate and ferric (III) oxide. These pigments are commercially sold under the trade names IRGACOLOR 3GLM, by Ciba Speciality Chemicals BV, Maastrict, Holland; and BAYFERROX 110M, by Bayer, Buckinghamshire, respectively. The pigments give the paint

its colour. Varying the relative proportions of these components alters the colour of the paint: increasing the relative amount of bismuth vanadate gives a more yellow colour to the paint, increasing the relative proportion of ferric (III) oxide gives a more red / brown colour to the paint.

The total proportion of bismuth vanadate and ferric (III) oxide in the paint composition of table 1 is 34% wt (including solvent), (ie. 23.5% plus 10.5%). This total amount can be varied. However we have found that if this total proportion of pigment is increased to over about 40% wt (including solvent) then the paint becomes too powdery and is unsuitable.

The two resins (silicone and acrylic) act as a binding medium for the pigments (bismuth vanadate and ferric (III) oxide) in the paint. The resins used in this example are: silicone resin in 50% (by weight of resin) xylene solvent and trace benzene, sold under the trade name DC805 Resin, by Dow Corning Europe, Brussels, Belgium; and, as the acrylic resin, polybutyl methacrylate also in 60% (by weight of resin) xylene, sold under the trade name SYNOCRYL 9122X, by Cray Valley Ltd, Newport, Wales. The choice and relative proportions of the binding agents is important in producing a high temperature stable paint. In this example the silicone resin provides good high temperature characteristics, but produces a paint that is too brittle if it alone is used. The acrylic resin balances the silicone resin. Experiments have shown that an approximate 1:1 ratio of the two resins produces an acceptable paint composition. Ratios, by weight, of silicone resin to acrylic resin in the range of 1:0.8 to 1:1.2 have also been shown to produce acceptable paint compositions. However using a ratio of 2:1 (two parts

silicone resin to one part acrylic resin) produces an unacceptable paint that is too powdery.

The solvent used is a blend of propylene glycol ethers. In this particular example of the paint the solvent is a commercially available mixture of 79.1% 1-methyl-2-propanol and 20.9% dipropylene glycol monomethyl ether, which is sold under the trade name of BANNERNOL 'E' (by Samuel Banner & Co. Ltd, Liverpool). As is known in the art, the proportion of solvent in the paint determines, in part, the viscosity of the paint. The proportion given in table 1 is for a paint with a viscosity of 83.7s at 15.8°C, measured using a B5 B4 cup as described in British Standard BS390 (1971). Such a paint composition and viscosity is suitable for brush application. It will be apparent that different proportions of solvent can be used as required. For example, for spray application of the paint, the paint needs to be thinned and a higher proportion of solvent is required, to produce a paint with a typical viscosity of between 27-31s at 20°C using a B5 B4 cup, in accordance with British Standard BS390 (1971). Other solvents that can be used will be apparent to those skilled in the art.

The paint composition as described in table 1 is made in a conventional manner. In an example method of making trial amounts, of approximately 0.5 litre, of the paint all the individual components, in the proportions given in table 1, were placed into a conventional ball mill. The ball mill was then run for a period of 16 hours to mix, mill, and blend the individual components to produce the finished paint. A ball mill comprises a ceramic cylindrical container into which a number of balls are placed, in this example the balls are of 3 different sizes. The ceramic container is placed on driven rollers which axially rotate the container causing the balls

therein to tumble within the container, so mixing and milling contents of the container.

The paint of table 1 is applied to an object using a brush to produce a coating of, for example, 18-37 μm thickness. The wet coating is then either air dried for one hour at ambient temperature, baked at 150°C for 30 minutes, or baked at 300°C for one hour. Other methods of drying the paint, known in the art, can though be used. It has been found that drying the paint at a higher temperature for a prolonged time, for example 300°C for one hour, enhances and brightens the colour of the paint. In addition it has been found that heating the paint, after it has dried, to a temperature higher than it has been previously subjected, produces a brightening of the paint that remains once the paint has cooled. This brightening of the paint improves the visibility of the paint and is of a benefit in some applications.

It will be apparent to those skilled in the art that the paints according to the invention can be applied to components in a number of other known ways, although as described above the composition may have to be varied slightly for the best results. For example more solvent than described in table 1 is required if the paint is to be sprayed.

In tests, metallic test panels of nimonic 75, a nickel alloy, were brush painted with the paint of composition shown in table 1. The wet painted test panels were then dried in ambient conditions for a period of 1 hour. This gave a paint thickness on the test panels of 20 μm. The paint on these test panels was then tested for thermal stability by subjecting the painted test panels to temperatures up to 600°C. The colour and condition of the paint on the test

panels was visually inspected both during the heating of the test panels, and once the panel had cooled. Only a slight brightening of the colour of the paint was seen during this test. This brightening being permanent and remaining once the test piece had cooled to ambient temperature. No other significant change in the paint condition was seen. It was concluded therefore that the paint was resistant to temperatures of up to 600°C.

In further tests, using similarly prepared test panels, drops of lubricating oils, oil fuels, and water were individually applied to the paint on the test panels. No visible effect on the paint was seen with the paint being substantially unaffected by lubricating oils, oil fuels, and water. A further test panel had hydraulic fluid applied to it and an acceptable resistance to hydraulic fluid was seen.

It will be appreciated that slight variations and modifications can be made to the composition, colour, and the method of applying the paint, without departing from the invention. The use of the paint is also not limited to high temperature applications or for use on metals.

Claims

1. A paint comprising bismuth vanadate, ferric oxide, a binder, and a solvent.

2. A paint as claimed in claim 1 in which the binder is a resin.

3. A paint as claimed in claim 1 or 2 in which the binder is a mixture of a silicone resin and an acrylic resin.

4. A paint as claimed in claim 3 in which the silicone and acrylic resins are in substantially equal portions.

5. A paint as claimed in claim 3 in which the proportions, by weight, of silicone and acrylic resins are in the range from 1:0.8 to 1:1.2.

6. A paint as claimed in any preceding claim in which the acrylic resin is polybutyl methacrylate.

7. A paint as claimed in claims 2-6 in which the resin is itself mixed with a second solvent.

8. A paint as claimed in claim 7 in which the second solvent mixed with the resin is xylene.

9. A paint as claimed in any preceding claim in which the solvent is a blend of propylene glycol ethers solvent.

10. A paint as claimed in any preceding claim in which the solvent is a mixture of 1-methyoxy-2 propanol and dipropylene glycol monomethyl ether.

11. A paint as claimed in claim 10 in which the solvent comprises substantially 79.1% 1-methyoxy-2 propanol and 20.9% dipropylene glycol monomethyl ether

12. A paint as claimed in any preceding claim in which the ferric oxide and bismuth vanadate make up to 50 % by weight of the paint composition excluding the solvent.

13. A paint as claimed in any preceding claim which comprises the following composition:

	% by weight excl. solvent
Bismuth Vanadate	30.5 %
Ferric III Oxide	13.5 %
Silicone Resin	28 %
Acrylic Resin	28 %

and the solvent.

14. A paint as claimed in any preceding claim in which there comprises substantially two parts of bismuth vanadate to one part ferric oxide.

15. A paint as claimed in any preceding claim which is of a substantially orange colour.

16. A paint as hereinbefore described with reference to the accompanying example.

17. A method of applying a paint of a composition as claimed in any preceding claim, comprising the steps of:-

a) Applying the liquid paint to an object,

b) Heating the object to drive off the solvent within the paint, and dry the paint on the object.

18. An article painted with a composition as claimed in any preceding claim.

The Patent Office

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Application No: GB 9717247.2
Claims searched: 1-18

Examiner: Diane Davies
Date of search: 20 October 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): C3T

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Other: Online: CAS-ONLINE, EDOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None found	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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